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Interak 1

SYSTEM NOTES

Modular "Rack and Card" 4MHz Z80A System

INTERAK 1

Introduction.

INTERAK 1 is a new name for an old idea. The name is short for "International Size Card Rack Mounting Computer", and the "1" is simply a name to distinguish one arrangement of cards from any other that may be devised.

The range of International size cards is by now very well established, and several thousands have been sold. When we first started selling this system all the cards were made and designed by another firm "Kemitron Electronics Limited" and so we called it the Kemitron system. As years have gone by other cards have been introduced by others so a name change was necessary (on similar grounds to those which dictate that a Hoover should not be called a Hoover unless it's made by Hoover). Kemitron Electronics is now a very well established and capable firm who supply powerful ready-made scientific computers to the "top" end of the market; our speciality is supplying bare boards and components to individuals, educational establishments and small industrial computer manufacturers, who don't wish to purchase a "ready-made"; but of course we're delighted to supply assembled systems if you wish.

The bus structure employed is called "ISBUS" which is based on the "K-BUS" originally devised by Kemitron, but with extra lines defined to allow later expansion to 16 megabytes of address space, and possibly microprocessors other than the Z80A.

Because of the modular nature of the cards, the system can be built up a little at a time, as funds and time available permit.

Brief Description of INTERAK 1

INTERAK 1 is built from a number of International size cards. These size cards (4.5" x 8") are the largest which can conveniently be fitted vertically in the common type of 3U (3-unit) high x 19" Rack. All the cards have the same bus definition (called ISBUS-A), and so can easily be interconnected in a way which permits "any card in any slot". A suitable printed circuit back board to take up to 13 cards is available, called ISBUS-1.1. Use of this back board leaves a few inches free at one end of the rack so that a power supply can be fitted. The power supply can be a simple home-made one for a small experimental system, but if you are really serious about computing in general and this computer in particular, the appropriate power supply should be a top quality switch-mode type, capable of powering a rack full of cards.

Power Supply

Like "How long is a piece of string?", a question on this is difficult to

answer directly, but as a guide, we suggest you budget for three or four hundred milliamps per card: about 5 Amps total.

With the introduction of the new DRM-64 card, the system is predominantly +5V - the individual data sheets for each card say if they need other voltages. (Small amounts of power from the +12V and -12V rails are still needed for the early EPROM programmer cards which use the +12V to generate the programming voltage, and the SIO-4 card which provides a dual RS-232 interface. These current needs are small and it is possible to supply them from one or more d.c. to d.c. converters such as the model ADID-12A10. The old Kemitron MXD-2 16K RAM card (if used) needs about a quarter of an Amp from the +12V rail and a few milliamps from the -12V rail. The MXD-2 cards cannot be powered by a small d.c. to d.c. converter, as the +12V load is much too great.)

A very useful high quality, crowbar protected "switch mode" PSU which can be considered for professional use is:

AC 9251 (197 x 108 x 52 mm): +12V @ 1A, +5V @ 6A, -12V @ 1A £58.50 + VAT

It is a commercial built and tested product, not designed specifically for Interak, but small enough to fit in. The 4" module mentioned in the hardware leaflet is useful as a source of materials and extrusions for mounting the power supply in the rack, but it needs some adaptation.

The system is based on a Z80A microprocessor, running at 4 MHz, and as the Z80A has built in arrangements for the transparent refresh of dynamic RAM, this is a natural choice for the majority of the read/write memory used in the system, particularly now that 64K of dynamic RAM can be obtained on a single card. (An earlier card, type MXD-2, which uses 16K of 4116s is still available for those users who prefer it, and we can supply further details on request.)

The functions of CPU and memory are kept separate. It would be possible to squeeze them together and put them on a single card, but this would prejudice the modularity of the system. For example, I am writing this with the aid of a disk system based on these cards. As the system I am using is now several years old it has the 16K cards which were the biggest available then. Nevertheless I can easily transfer the CPU card to another rack where the current 64K card is in use. I well remember the first time I used the Z80A - it was in an early Kemitron system which had just 1K of RAM, which I later expanded with 16K RAM cards. I'm telling you this not just to bore you with my great antiquity but to show how long-lasting hardware can be if it is modular. Name any other computer of 1978 vintage which had 1K of RAM to begin with which is still functioning let alone in daily use in a fully fledged CP/M disk system! In short, a bright idea now, about cramming a card full of the current chips, will not be so bright in years to come when the chips are no longer current. The voice of experience speaks!

A few years after this computer was launched the favourite computer in schools and in the home was the PET (perhaps you remember it - the one that looked like the robot dog K-9 in the TV series Dr Who). Although there must be plenty still in use, the PET is no longer the favourite computer; I don't mean to say its manufacturers Commodore have slipped behind, far from it, their VIC 20 and Commodore 64 computers are doing fine, but I am trying to say that even the most popular of non-modular computer is doomed to obsolescence sooner or later, and this is why I'm such a fan of the modular plug-in card system.

My firm has a Qume printer which is suffering from being non-modular: it

uses a funny old F8 microprocessor and ancient old 2708 EPROMs. Although it has plenty of life in it yet it looks as though it will have to be retired long before it really should - spare parts and supplies are hard to obtain and hardly anyone knows how to fix it when it goes wrong. Qume are still manufacturing daisy wheel printers galore, but not to the original design. If only it had been an Interak product I could have discarded the old fashioned parts and put in more modern ones; as it is, the only way I can get up to date is to throw the whole printer away!

A standard ASCII encoded parallel keyboard is used for input and control, and a standard 625-line domestic television set or monitor for output. An ordinary audio tape cassette recorder can be used for the storage of programs. By use of other cards (some not available from us but from other suppliers such as Kemitron Electronics), printers can be connected, EPROMs can be programmed, sound generators can be connected, floppy disks, relay outputs, opto-isolated inputs, VDU terminals, analogue-digital and digital-analogue convertors, and so on.

The best selling card of the lot is the breadboarding or prototyping card, DIP-1. This is the one which you use for your own circuits (possibly cribbed from a computer magazine, but certainly adapted and built by you). When you start adding your own boards like this you know you have arrived. Usually the space for the 13 cards in the rack is enough for anyone, but there are one or two computer freaks among our users who have expanded their way right out of their first rack full and are now into their second or third! Other computers do allow a certain amount of experimentation of this kind but it is rare for them to allow users' add-ons to be plugged into the innards of the computer and enjoy equal status with the rest of the system. More often, even with the better home computers, all you are allowed is to plug in a few tacky bits of ribbon cable into sockets condescendingly called expansion ports. The smart plastic cased computer looks pretty awful once a rag-bag of the user's circuits are added round the back, but the Interak computer was designed specifically for this activity and takes it in its stride. The industrial style of 19" rack was expressly designed to take neat rows of plug in circuit boards, with perfect mechanical rigidity and proper interconnections from card to card.

A particular feature is that wherever possible RAM is used in preference to ROM or EPROM. For example, the monitor/operating system ZYMON 2 is supplied in an EPROM, but actually copies itself into RAM and runs there. This means that the memory space beginning at 0000 can be used for other purposes in the future by the user. (For example if the user is developing his own operating system, or perhaps if the CP/M floppy disk operating system is to be installed later; CP/M needs RAM beginning at 0000, and its use is impossible if the space has been filled with a ROM or EPROM).

Similarly, the BASIC has been chosen to run in RAM. This means that it can easily be removed and replaced by other languages (e.g. Pascal, Forth, Lisp, ADA, Fortran etc. should versions become available for this system), and certainly anyone who has written a program in assembly language will know how valuable large uninterrupted areas of RAM are when using an assembler program to assemble his source code, a procedure which gobbles up RAM if the luxury of disks is not available.

The Z80A-CPU directly addresses a 64K Memory Space and a 256-byte I/O (Input/Output) Port Space (but extra hardware can be added in future designs to render these spaces practically unlimited, easily hundreds of times larger, by a "mapping" technique). Some suggestions as to what should be allocated to these spaces are implicit in the design of the INTERAK 1 computer. A memory-mapped VDU is used, for very high speed and easy

manipulation of the display, and the EPROM programmer is memory-mapped also. (There is perhaps less benefit attached to the idea of a memory-mapped EPROM programmer, but it has been retained for the time being to suit the existing EPROM programmer designs). In consequence the whole 64K has not been filled with RAM. The first 48K is RAM, leaving 16K at the top of the memory for "odds and ends" such as the items already discussed. The preferred memory card, the 64K DRM-64, has arrangements on it to disable selected 4K "pages" for occasions such as this, where too much memory is actually an embarrassment.

A few of the I/O Ports have been allocated to such items as tape and printer UARTs, Keyboard, EPROM Programmer control, and so on, but the majority are available for the user's own special purposes.

A complete system can be constructed using cards already in the range, but the INTERAK 1 computer uses some new cards which are being designed especially for this purpose. This is mainly because the appropriate cards in the existing range are showing distinct signs of age, and more modern and convenient techniques are now possible. For users who are in a great hurry to begin, details of the circuits can be provided so that users can construct them on prototyping cards if they wish.

No Gimmicks

It is perhaps important to point out that INTERAK 1 is not one of the latest breed of "gimmick" computer. In other words it is built in a traditional way, using standard readily available parts, and is designed to last for many years. This does not make us as a firm as rich as we would like, but at least we can sleep with a clear conscience. The truth of what we are saying is borne out by the fact that we have been established since 1970, and the first circuit boards we offered in this range six years ago in 1978, will still fit into the latest system.

You can get an idea of what we're on about by contrasting our marketing with that of the famous firm Sinclair, who although they were established a few years before us came into computing some time later: Their proud boast is that they have introduced five computers (MK14, ZX80, ZX81, Spectrum, QL) in as many years - our proud boast is that we haven't!

The latest and greatest gimmick, practised by others, is the use of "ULA" chips. "ULA"s, which we jokingly refer to as "Unobtainable Logic Arrays", are in fact "Uncommitted Logic Arrays", supplied by semiconductor chip manufacturers. They are partly finished integrated circuits, and the final interconnections are added to suit the particular large scale manufacturer (e.g. Sinclair, BBC Computer, etc.). We ourselves have looked into the question of using these chips, since they can become cost-effective for relatively quite small quantities of a thousand chips or so, but have so far decided against them for reasons which will become obvious when you read what follows:

The great beauty of the ULA technique from such suppliers' point of view is that the design can be kept secret and they can retain themselves as sole supplier of the chips at whatever price they want, for as long as they want; to say nothing of the fact that they can get the chip count right down. The only slight problem is that the design, once in, is "frozen", and as many units as possible have to be sold as quickly as possible, (and work commenced at once on the new model which will replace it!).

From the customer's point of view, the ULA chip has less to commend it.

Granted, the consumer gets a modern, cheap product, at a very competitive price, but if he asks for a spare "ULA" chip or data sheet he is quite likely to be sent away with a flea in his ear instead. Very often people buy computers specifically to find out exactly how they work, and it is a disappointment for them to find that the secret is merely "connect all the ULA chips together and switch on, sorry no further data available"! Once the inevitable obsolescence is reached, and this year's latest model becomes last year's obsolete model, then it is practically impossible to obtain spares or service, and the whole unit has to be scrapped in the event of trouble. The technique has been carefully refined in say the motor-car industry (you know, when a screw breaks in your carburettor you can't buy a spare, you have to replace the whole unit), but at least in that field you have the excuse that you have no choice, all the manufacturers are the same. In the computer field however you do have a choice.

All of the new computers seem to use increasingly these special "ULA" chips which it is the work of genius to include in "ZX81s", "Orics", "Electrons", "QLs" and the like, but would be the work of lunacy to include in Interak. (And ironically these different conclusions are drawn from identical facts; ULAs are attractive in "Electrons" etc. precisely because they are "single-sourced", they have to be mass-produced, and their inner workings can be kept a total secret: the very reasons they are unattractive for use in Interak!)

To test and see whether or not you are a suitable INTERAK 1 customer, consider what we have said above, and answer the following question: Is it better for a designer to use say 20 readily available 74LS series chips or a single "ULA" chip? It is a trick question, because there is no right answer, but it may help you sort out what is the basic difference between a modular rack-and-card computer such as INTERAK 1, and the "consumer" computers you find in a microcomputer shop (or Boots or WH Smiths), and most importantly, sort out which approach is best for you.

Rack-and-Card

The Rack-and-Card construction is the secret of how the INTERAK 1 computer has gained its "Peter Pan" like quality of never growing old. As new chips come along it is easy to design a card to use them, without having to throw away all that has gone before. An example of this is the continuing advancement in the size and types of EPROMs available. One of the optional features of the INTERAK 1 is the ability to program EPROMs. Way back in 1978, the standard EPROM was 0.5K and was called 5204; it was very awkward to program, needing a -50V supply, and the much more attractive replacement then was the 2708 1K. Nowadays, the 2708 is the old-fashioned one, and the 2K 2716, the 4K 2532 or 2732, and 8K 2764 and beyond, are the current favourites.

Needless to say, without the flexibility of plug-in cards, the system would have been obsolete long ago. It can still be the same old system which is known and loved, but a new user can keep it bang up to date. The technique is the same as that we are all hoping for in "spare part" surgery. The human body is full of the biological equivalent of "ULA" chips: no data sheets are available, and the designer keeps the details of their working secret. Eventually the whole system has to fail for the want of knowledge how to repair it, or for the supply of spare parts. Just imagine the demand there would be if you could have your body built in the INTERAK 1 rack-and-card system: as you got old, and couldn't think as well as you used to, or if you got rheumatism, all you'd have to do is plug in a new module to bring your performance right up to date! There's probably no

doubt that everyone would pay a little extra to have a modular rack-and-card body system, the question is would you pay the extra to provide the same facilities for your computer?

Benefits of the Modular Approach

The main merits in the Modular Approach are best emphasised by pointing out the demerits in the non-Modular style of computer. Apart from the main disadvantage already discussed, i.e. the design is "frozen", and therefore starts to become obsolete from the moment it is purchased, another disadvantage is that you have to work how far you will be going before you have the knowledge and experience to say. We seem never to sell people their first computer, we sell them their second - it seems that before anyone can recognise the merits of INTERAK he first has to waste his money on a few false starts.

In fact it is fruitless to compare a build it yourself Interak with the commercial packaged computers: they are totally different. Because the "hype" associated with packaged computer marketing makes clear thinking on this subject difficult, it is better to take a more homely analogy: If we were trying to get you to be interested in "do it yourself" (and in a way we are), how could we explain the benefits of purchasing the tools and equipment over simply going out and purchasing a ready made product? If you want a wardrobe why not buy a wardrobe? - it's much cheaper and quicker than buying the tools and materials to build one yourself. True enough. So if you feel the same you'll be best with a "ready made" computer; but if you don't then perhaps you are beginning to see what Interak is all about.

Putting modesty aside for the moment, we think that we are fairly competent computer designers. And how did we become so? Not by going to University (although that was a help), and certainly not by buying the first ready made computer we could afford (although we did that too). No, the way we learned our trade was by practical work with a system just like Interak (i.e. the "Kemitron" system, from which Interak is derived).

We think that even these days it has to be fairly true that not everyone has a few hundred pounds they can throw around like that, and even if they do have the money they may still not want to spend it all at once.

Our experience, gained over many years, is that people generally prefer to spend much smaller sums; a typical purchaser may buy the circuit board and its Manual one month, study it and look around for any chips he may be able to beg borrow or steal, and then buy any parts he hasn't got the next month, and so on. Sometimes a lucky user will arrange for his or her major expenditure to fall into the Christmas season, and can often persuade Santa to provide a Monitor or Printer.

The slow evolutionary process of building an INTERAK 1 computer little by little is perfectly feasible, because it isn't a race against time. The INTERAK 1 computer isn't going to be obsolete before you've built it, for the reasons already previously discussed at length.

Note: There have been one or two suppliers of modular style plug in cards in the past who have carried the idea of limited initial expenditure a little too far. In order to get the initial cost down, they produced very simple computers, which could stand alone and work in a very crude fashion. They had (and for all we know still do have, although we haven't seen them advertised for a while) "hex. keypads" for limited data entry, and partially decoded address lines, with an unbuffered bus.

The reason we think this is carrying the technique too far is that it gets the initial cost down by lumbering the customer with things he will have to throw away at the next stage. Fifty pounds or so may well produce a working computer within the "Meaning of the Act", but if that alone were the object, something like a Sinclair ZX-81 would be a much better purchase. Our feeling is that INTERAK 1 customers will enter into their purchase with their eyes open and will not need tricking into thinking that a small hex. keypad and limited memory is of any use by modern standards.

The idea is to enable the user to work up gradually to a system as complicated as he wants, but to take it in easy stages, perhaps building a card every month or couple of months. When you think of buying a computer kit, the whole idea is to help you get to know how computers really work. It is very difficult when you are faced for the first time by a non-modular computer, full of ULA chips, to even begin to understand what it's all about. If you build a modular computer, a card at a time, at your own pace you will then have the maximum chance of understanding its architecture, and the way the various modules work together to make up the whole system.

There was once a man who wanted to know how machines like amusement arcade video games worked. He bought himself his own personal computer and read the Manual from cover to cover. Eventually his friends, knowing of his interest, asked him to explain in detail how the video games worked. "It's easy." he said, "Just the same as my own computer at home - except you put 10p in the slot and press the red button marked 'Start'." (Don't laugh, it could happen to you!) This is the same as an understanding of TV - we all know how the pictures fly through the air, are trapped by the aerial, trickle down the co-axial lead and somehow are sprayed onto the cathode ray tube. We <u>think</u> we know all about the inner workings of TV but all we really know is how to <u>use</u> one. There are people who do know more, and have found out by study and experiment how TV actually works: these are the kind of people who build a computer like Interak.

An example of how people who want to understand the subject are not properly catered for is the recent series on Microcomputers shown on TV Over and over again the presenters stressed that we should not be frightened of computers, and anyone, no matter how small his brain, could use them. It was just like driving a motor car - after all you don't have to know how a car <u>works</u> in order to go for a spin. Well true enough, you don't; but what if you <u>do</u> want to know how it works - what if it breaks down on some lonely wet and windy night, there is no substitute then for practical experience. To carry the analogy further, the person who actually has built his own car from individual component parts will be ideally placed to have a complete and utter understanding of the detailed working of the machine, (and probably if he did build it himself it would be less likely to break down anyway). The analogy will even stretch a little further to include the point about whether readily available components or "ULA" chips should be used in the design, but we will leave it at that for now!

<u>Disks</u>

Although 5.25" drives are now appearing for £100.00 or so, (and there are some interesting developments in miniature 3" sizes - which can be used equally well as they are usually electrically compatible), we think that if CP/M is to be used serious consideration should be given to 8" disks. The reason is that there is a lot of software very cheaply available for CP/M, but with the catch is that it is hard to install on 5.25" disks because there are so many different disk formats around, and you're bound to have the wrong one! On the other hand the familiar 8" single density soft

sectored 128 byte/sector IBM format is so well established now that it is almost impossible to go wrong.

The data is recorded on 8" disks on tracks at fixed radii; did you know that on 5.25" drives the numbers, positions and pitch of the tracks has not been standardised, this being left to the individual whim of the manufacturer? Very nice for the manufacturers for "locking in" customers, but not so nice for the customers who are "locked in".

The general trend towards the smaller drives shows an ambivalent attitude to performance improvements by the manufacturers of new computers, especially the ones who are trying to demoralise 8-bit computer users by saying 16-bits are faster. As it happens the main bottleneck in processing is often getting data to and from the diskette itself - as 8" drives transfer data at precisely double the rate of 5.25" drives (and have double the storage) it is curious how the 16-bit performance freaks proceed to cripple their system by retaining the 5.25" drives.

8" Double Density Transfer Rate:	500 kbits/sec	(1000 Kbyte diskettes)
5.25" Double Density Transfer Rate:	250 kbits/sec	(600 Kbyte diskettes)
5.25" Single Density Transfer Rate:	125 kbits/sec	(250 Kbyte diskettes)
Microdrive Tape Transfer Rate:	120 kbits/sec	(100 Kbyte cartridge)

Note that the Interak floppy disk interface board (in development) will cater for as many standards as possible - in this respect the latest 3" and 3.5" drives are very interesting. There are two speeds of rotation for 3.5" drives; the slower one gives the same transfer rates as 5.25" drives and the faster one the same as 8" drives. (Since the average home computer, and even the small business computer can only cope with the slower data rates, they will not be able to get the full performance out of the 3.5" types - another point in favour of Interak.)

Industrial Users' Development System

A very useful additional benefit which can be gained from the modular rack-and-card approach is the suitability of the system for Industrial Development work. Of course this is not limited merely to Industry - the term is used only to indicate the general kind of application, and in fact there are a gratifyingly large numbers of these computer cards already at work in colleges and universities, ITECs and so on, as constructional projects, or as demonstration pieces to show people on training courses exactly how a computer is made from quite simple subsystems.

Being such a system INTERAK 1 can be used to demonstrate the feasibility of a project, say for example a robot controller. The software can be developed on INTERAK 1, using interface cards (preferably from the standard range, but developed specially if necessary) plugged into the INTERAK 1 rack itself.

Very often you see PET or Apple or more modern "ready made" computers used for this kind of demonstration in schools and colleges. Normally the next stage of development (if "ready mades" are used) is then to build up a dedicated "target" system, which involves all the time and expense of laying out printed circuit boards and so on; but in an INTERAK development system, it is a simple matter to take out all the cards and then replace only those which are needed in the "target" system. The range of cards which is available includes a ROM/RAM card which is ideal for those applications for which only need a few K of memory and for which the 64K on the Dynamic RAM card would be "over-kill". And of course the protoyping card DIP-1 comes into its own here.

The cards in the target system can be interconnected using a short length sawn from an ISBUS back-board, and the software can be transferred in an EPROM, programmed on the INTERAK 1 system itself. For very involved software development an RS-232 serial interface could be programmed to pass programs and data to the target system or a large "main-frame" computer if you happen to have one lying around.

In the event of some difficulty being encountered in the finished target system, the standard cards can be withdrawn and placed back in the INTERAK 1 system, making it useful as a card tester, with or without special test software being written.

What to do if you are in Trouble

You may be a little frightened about building from scratch an item as complicated as a computer. We are now certainly in a position to set your mind at rest there. During all of the years we have been selling this type of card we have never left anyone stranded. The vast majority of people seem to enjoy instant success, or if not, are able themselves to locate and find any errors they have made, (with assistance in fault finding from us if necessary).

A few people have preferred to send their card(s) back to us to see if we can help. We have so far never been defeated, and have managed to find and repair every fault presented to us, and most importantly, we have so far made no charge whatsoever for our labour in locating the fault. (This has been very generous, as in some cases faults have taken more than a whole working day to locate, and have eventually proved simply to be due to bad workmanship, e.g. impatiently and badly soldered joints etc.)

We are stressing this point, because we have heard a joking comment on some companies who it is said make no money on their kits, but make a fortune on the repair charges!

People from all walks of life (e.g. welders, joiners, accountants, journalists etc.) have amazed themselves by enjoying success they never thought possible, and yet we have had the odd lecturer in computing who has been totally unable to get his system going at all, so you never can tell until you try! Actually, a fair number of purchasers of modular computers are lecturers or teachers, as they obviously have a vested interest in learning all about the subject from the inside out (literally!). It is embarrassingly true that a student on a computing course who has had some practical experience often can appear much cleverer than a teacher who hasn't!

INTERAK 1 DETAILS

Not Included

It is assumed that the user will already have, or can provide himself with, the following items. We can of course supply them if required, but they have been omitted because many users may already have them or be able to make or obtain them more cheaply themselves:

1. 625-line TV set or video monitor
2. ASCII Keyboard and case
3. Tape cassette recorder
4. Case for computer
5. Power supply

Minimum Cards and Software for a Working System

The cards and software below are needed to construct a working system. If they are being purchased at intervals, a step at a time, then the following order can be followed to get the maximum activity from the system at each stage:

1 off	VDU-K	VDU Interface to 625-line TV Set
1 off	ISBUS-1.1	13-slot Back board
1 off	MZB-3	Buffered CPU with Power-on-Jump
1 off	ZYMON 2	2K Monitor EPROM (on MZB-3 Card)
1 off	DRM-64	48/64K Dynamic RAM Card
1 off	LKP-1	Latched Keyboard Interface

Additional Cards and Software for full INTERAK 1

In addition to the above cards and software, the following items are needed to bring the system up to the full INTERAK 1 specification. As before they are presented in the order which will give the maximum activity from the system at each stage:

1 off	DTI-1	Dual Cassette Tape Interface Card
1 off	ZYBASIC 2	Floating Point BASIC (from Interak Supplier)

(If you require a larger BASIC, ask the User Group for more information on the following):

1 off XTAL 14K BASIC, User Group Implementation (from User Group)

Further Optional Cards

The list below which mentions "Further Optional Cards" is based mainly on the Product range of "Kemitron", the originators of this system of cards. The list needs revision in that some cards have been dropped by Kemitron and some are no longer available as "Bare Boards". Most seriously this affects the Floppy Disk Interface, which can now be supplied by them only to special order, as a ready-built K-BUS compatible card, (for a few hundred pounds). For those users who require a bare board and kit, like the other Interak system cards, an "Interak" disk interface card (FDC-1) is in development, and will be made available to Interak users.

We are ourselves still continuing to think about a more exotic VDU card or cards, combining some or all of the following features:

80 characters, high resolution graphics, maybe colour.

(The reason for the "maybe" in "maybe colour", is because 80 characters and colour (with ordinary display devices) are mutually incompatible. We know there are plenty of well-known computers which do claim all these things, but we don't think they look too good on any ordinary colour TV or monitor; they are always demonstrated on a high resolution colour monitor - we rather fancied buying one ourselves until we found out they were £1500! Nevertheless, just to show that Interak is capable of anything the user can afford, a design is under active consideration.)

So that we can not only keep up with the Jones' but go one better, we may well organise a system with two screens, one monochrome for text and ordinary graphics, (for communication between the user and Interak), and the

other the all singing all dancing model used to display the works of art which the computer and its user produce. In other words, true to the Interak principle, the new VDU could be an addition, not a replacement. Be the first on your block with a 2-screen computer!

Other Designs

A couple of designs for cards for Interak 1 can be made available to users (for a modest fee). These are cards which it is intended to produce, but which have been deferred so that the more glamorous new cards can have priority. They can be built on the DIP-1 Card, and are as follows:

XPSG-1	Dual Programmable Sound Generator + I/O Ports
XPCG-1	Programmable 128-character high resolution graphics character generator for VDU-K.
XPRN-2	Parallel Printer Interface.

The following cards are not part of the standard INTERAK 1 Computer, but give an idea of cards which are available for special purposes. They are in no particular order; (some are revisions of earlier designs and some are new proposals which may or not be in production). Many of the cards are manufactured by Kemitron, the originators of the system, and are only available directly from them built and tested. Some have slightly different bus allocations to those of the INTERAK 1. Mostly it is easy to alter them to suit INTERAK 1, but in some cases parts of the INTERAK 1 bus would have to be abandoned. (Any cards produced under the control of Greenbank Electronics are INTERAK 1 compatible, but other manufacturers using this card size use their own particular variation of the bus.)

Purchase from Interak Suppliers (Check Availability!):

MXA-3	8K Static RAM (2114 type)
MXD-2	16K Dynamic RAM (4116 type)
PRM-8	2708 EPROM Card
RRM-14	Mixed EPROM and Static RAM (2716 & 2114)
IP-2	Opto-isolated Input Port
OP-3	Relay Isolated Output Port
SIO-4	Dual RS-232 Printer etc. Interface 300-9.6k Baud
PP-2	EPROM Programmer

In Preparation:

XFDC-1	Double Sided Double Density Floppy Disk Interface
XPSG-1	Programmable Sound Generator
XPCG-1	Programmable Character Generator
XPRN-2	Parallel Printer Interface Design

Purchase from Kemitron (Mostly Only Built and Tested Boards):

DC-4	Double Sided Double Density Floppy Disk Interface
HDA-1	Hard Disk Adaptor
MXD-6	256K Dynamic RAM
MZB-4	Z80A-CPU
-	Analogue to Digital, Digital to Analogue
-	Printer Interfaces etc., etc.

Memory Map

The Memory Map describes a total 64K space or "chapter", divided into 16 4K "pages", as follows (Addresses are in hexadecimal notation):

Page	Address		Function
0	0000-0FFF		User RAM/ZYMON 2 and stack
1	1000-1FFF		User RAM/ZYBASIC 2 variables and RAM
2	2000-1FFF		User RAM/ZYBASIC 2 Text
3	3000-3FFF		User RAM/ZYBASIC 2 Text
4	4000-4FFF		User RAM/ZYBASIC 2 Text
5	5000-5FFF	48K RAM	User RAM/ZYBASIC 2 Text
6	6000-6FFF		User RAM/ZYBASIC 2 Text
7	7000-7FFF		User RAM/ZYBASIC 2 Text
8	8000-8FFF		User RAM/ZYBASIC 2 String Variables
9	9000-9FFF		User RAM/ZYBASIC 2 String Variables
A	A000-AFFF		User RAM/ZYBASIC 2 Interpreter
B	B000-BFFF		User RAM/ZYBASIC 2 Interpreter
C	C000-CFFF	Reserved	Firmware, and/or EPROM Programmer
D	D000-DFFF	Reserved	Firmware, and/or EPROM Programmer
E	E000-EFFF	2K/4K ROM	MZB-3 On-board ROM (e.g. 2K ZYMON 2)
F	F000-F3FF	VDU	VDU-K Video RAM
F	F400-F7FF	Reserved	Video RAM Expansion
F	F800-FFFF	Reserved	VDU-K Programmable Character Gen.

It should be stressed that the above mapping is that of the INTERAK 1 system only, and is based on the two main items of software offered (ZYMON 2 and ZYBASIC 2). If you use your own software you can choose your own allocations. As the RAM is so "cleanly" organised, it is very simple to run other software if it is available to particular users (e.g. PASCAL, FORTH etc.) Also note that the provision of RAM starting at 0000 makes it very easy to bring in disks, especially the CP/M operating system later.

I/O Port Map

There are 256 I/O Ports directly available in a Z80A-based computer. In INTERAK 1 they have been allocated so far as follows, but some minor changes may be made from time to time:

Port	Name	Function
00	Reserved	UART Disk system console (Status)
01	Reserved	UART Disk system console (Data)
02	Reserved	UART Disk system Printer (Status)
03	Reserved	UART Disk system Printer (Data)
04	CASS0,1	UART INTERAK 1 Tape Cassettes (Status)
05	CASS0,1	UART INTERAK 1 Tape Cassettes (Data)
06	PRN1	UART INTERAK 1 Printer (Status)
07	PRN1	UART INTERAK 1 Printer (Data)
08-0F	Reserved	UARTs for Serial I/O
10-2F	User	User's Ports
40	KEY0	INTERAK 1 Parallel ASCII Keyboard Port
41-4F	Reserved	Parallel I/O
60-6F	Reserved	Hard Disk Adaptor Ports
70-8F	Reserved	Floppy Disk System Ports
C0-CF	PSG	Programmable Sound Generator(s)
E0-EF	Reserved	VDU control Ports (High Res etc.)
F0	PP	INTERAK 1 EPROM Programmer Control Port
FF	MEM	Memory Control Port

Interaktion User Group

An informal User Group called "Interaktion" was formed in 1982, and has several hundred members. It is independent of the suppliers of the Interak cards, and has a range of unique software, with various benefits for members (technical book library, discounted prices on printers etc.)

It is an independent group and supplies its own range of software for Interak 1; a very recent introduction being a User Group implementation of the highly respected XTAL 14K BASIC. The "Interaktion" Newsletter has extra information and notes on the Interak System, future developments and so on.

For a free copy of the Interaktion Newsletter and the current membership rates send 30-40p in stamps (for postage and packing) to:

Interaktion User's Group
c/o Mr P.P. Vella, 19 Ford Drive, Yarnfield, Nr. Stone, Staffs. ST15 0RP
(Telephone 0785 760 250)

Remember it is a spare-time activity, so don't expect a slick commercial service.

Hardware

If not included with this a further descriptive leaflet can be supplied on request. It includes details of a suitable rack, case, and other hardware such as the necessary edge connectors, card guides etc.

Keyboard

Originally we did not supply a keyboard, since suitable (parallel ASCII encoded & strobe) types are widely available at reasonable prices (£15.00 to say £50.00) on the "surplus" market, in which we don't deal ourselves.

However, we were asked quite regularly to supply a keyboard for professional installations, which require a top quality attractively cased keyboard. We can supply (to special order) the keyboard which we use ourselves. It is 5V only, microprocessor controlled, with N-key rollover, 80+ keys, mounted in a very pleasing case. The price is £125.00 + VAT.

Software

Although "Interaktion", the User Group for the Interak Computer, is much younger than the computer system itself, it is now beginning to provide a most useful additional support for Interak 1, particularly regarding software - a list from the Newsletter is presented below to give an idea of the software available, and of course disk users should not forget that thousands of programs are available on disk from the CP/M User Groups for a purely nominal charge.

NAME	DESCRIPTION	AUTHOR	CODE	SUPP.	FORMAT
ZYMON 2	INTERAK monitor	BE	MC	GB	A
ZYBASIC 2	INTERAK BASIC	NK	MC	GB	A
ZYMON 2	INTERAK monitor	BE	MC	UG	C
ZYBASIC 2	INTERAK BASIC	NK	MC	UG	C
XTAL BASIC	14K BASIC	XL	MC	UG	A
XTAL BASIC	14K BASIC	XL	MC	UG	C
FIGFORTH	High Speed Language	CD	MC	UG	A,C
ASM 32	Editor Assembler	NK	MC	UG	A

ASM 64	Editor Assembler	NK	MC	UG	C
HC DISASS	Simple Disassembler	HC	MC	UG	A
REVAS	Better Disassembler	DP	MC	UG	A
MEGABUG	Debug/Training Package	RO	MC	UG	C
VELTEXT	Text Editor	PV	MC	UG	A,C
Lander	Lander Game	PV	XL	UG	C
Towers	Towers Puzzle	PV	XL	UG	C
Crazy Maze	"3D" Maze Game	PV	XL	UG	C
Avalanche	Blob Dodging Game	DB	ZB2	UG	A
Monster Mash	Maze Game	BE	ZB2	UG	A
Graph	Graph Plotter	MC	ZB2	UG	A
Space Invader	Blob Dodging Game	SW	MC	UG	C
Rakovsky	Chess Game	NK	MC	UG	A,C
AC10.XX	(Chess Character EPROM for VDU-K)		--	UG	A
Happy Sums	Fun maths	PV	ZB2	UG	A
Hangman	Spelling game	PV	ZB2	UG	A
O's and X's	Game	PV	ZB2	UG	A
Pools Pick	Random Draw Selector	PV	ZB2	UG	A
Count	Learn to count	PV	ZB2	UG	A
Dice Pontoon	Simple Game	PV	ZB2	UG	A

Key: MC machine code. ZB2 ZYBASIC. XL X/TAL BASIC. GB Greenbank. UG User Group. Formats: A = 32 x 24 VDU-K, B = 64 x 16, C = 64 x 24 VDU-2K.

(The format mentioned above for "VDU-2K" is one to suit the VDU-K card modified by the user to allow twice the normal number of characters; see Newsletter number 2 for specific details.)

Manuals

Comprehensive Manuals are available or are in preparation for all the Interak cards, and prospective purchasers are urged to buy one or more Manuals first, so that they can make sure that they can be sure they are not making a mistake before it's too late.

A modular computer system will last a long time and if used to the full (disks etc.) can cost a fair amount of money, so a pound or two invested in the Manuals will be money well spent if it saves you making a several hundred pound mistake!

The Remainder of this Leaflet

The remainder of this leaflet deals with the detailed aspects of the individual cards and other items which go to make up the INTERAK 1 computer. The prices of the various items are given at the very end.

An attempt has been made so far to make the style of this leaflet as light as possible to read (i.e. plenty of exclamation marks and outrageous comments etc., to keep up your interest). There is less scope for this in the data sheets which follow, so they will be even more boring to read ("Surely not!"), so skip quickly to the end if you wish.

Yours sincerely,

David M. Parkins

David M. Parkins, B.Eng., (Hons.)